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NEW SOILS MAP OF THE USSR (NOVAI POCHVENNAII KARTA SSSR).(U)

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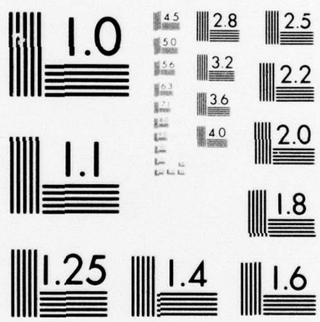

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NEW SOILS MAP OF THE USSR

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CORPS OF ENGINEERS, U.S. ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
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Small-scale soil maps reflect the theoretical level achieved by soil science and completeness of knowledge on the soil mantle. The diversity of scientific and practical tasks which are solved on the basis of such maps stipulate the following three requirements to them: (1) maximum informativeness; (2) clearness and readability (3) high accuracy. The higher informativeness of the New Soil Map of the USSR is attained by depicting on it the structure of the soil mantle and showing not only the classification units but also the

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spatial and geochemical interrelations between them.

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NEW SOILS MAP OF THE USSR

Moscow POCHVY MIRA in Russian, Vol VIII, 1974, pp 36-41

[Article by I. P. Gerasimov, V. V. Yegorov, N. A. Karavayeva, Ye. N. Rudneva, I. A. Sokolov, V. O. Targul'yan and V. M. Fridland, Soils Institute imeni V. V. Dokuchayev, All-Union Agricultural Academy and Geography Institute USSR Academy of Sciences]

[Text] National overall soils maps always reflect the level of development of soil science attained at the time of compilation of a definite map: its theoretical attainments and the degree of study of the soil cover in the country. The possibilities of using such general soils maps are numerous: for taking inventories of soil (land) resources; as a scientific basis for planning national measures for using and increasing the productivity of land resources; for use as study aids at intermediate and higher educational institutions; as initial material for compiling other scientific and scientific-applied maps and diagrams, etc. General soils map are of enormous importance as initial material for scientific analysis for the purpose of establishing, refining and checking the principal laws of genesis and geographical distribution of soils.

These problems predetermine the three principal requirements on general soils maps: 1) maximum information capacity, 2) they must be graphic and easily legible, 3) the highest possible accuracy. This communication is devoted to an exposition of the ways to solve these problems in the course of compilation of a new general soils map of the Soviet Union. The diversity of natural conditions and soils over the enormous territory of the country makes it possible to hope that much of this experience is desirable for application in compiling soils maps of other countries and the world.

An increase in the information capacity of a general soils map is achieved by means of: a) optimizing the list of cartographic units employed on the map; b) changeover from the mapping of primary and secondary soils to the mapping of the structure of the soil cover showing both its composition and spatial patterns in the distribution of soils within the defined contours and c) introduction to the soils map of information supplementing its soil criteria.

The basis for work on the compilation of an optimum list of cartographic units is a soils classification. However, cartographic units do not coordinate in classification respects and can have different taxonomic ranks corresponding to a definite systematic soils category (type, subtype, genus, species). Special annotations are also used, including definite sets of classification units (for example, similar genera of close subtypes -- dark chestnut and chestnut, deeply effervescent). A special group of annotations is used for taxonomically unclear soil communities (for example, "high mountain desert soils"). The symbols in the legend also include nonsoil formations (sand, talus, etc.).

In compiling a list of cartographic units the following are taken into account: 1) occupied area and economic importance; 2) degree of genetic singularity and specific nature of economic use; 3) possibilities of depicting, without contouring, of independent cartographic units (for example, residual calcareousness of soils of arid areas, presence of "dry" permafrost in the soil profile, etc. are not depicted using special soil areal symbols, but by special point symbols); this approach makes it possible to shorten the list of symbols on the map.

In developing the list we used the following theoretical approaches to the classification of soils: soils are classified primarily as natural historical bodies having a regularly caused complex of genetic horizons and their properties. The selection of criteria and properties used in the classification is made on the basis of Dokuchayev's initial synthetic concept of soils as a body genetically derived from the conditions of the natural medium formed by some combination of elementary soil-forming processes (ESFP). This concept during recent years has received its laconic expression in the formula "soil properties - soil-forming processes - soil-forming factors."

Taking into account that the correlation between environmental factors and ESFP is multiple and that the correlation

between ESFP and the noted properties can be both polymorphous and isomorphous, in defining the classification units we felt it necessary to rely primarily on the combination of genetic horizons and diagnostic criteria uniformly determined in the soil profile. The correlation between criteria and processes and through them with environmental factors is seemingly an ideal foundation for the classification of soils and the system of cartographic units; in itself the system is structured on the basis of stable combinations of soil properties.

With such an approach, the systematization of the soils and the map legend assume the most objective character, at the same time retaining its genetic basis. The differences in environmental factors or ESFP in themselves, without reflection in stable and clearly expressed soil properties, cannot serve as a basis for defining soil units in the legend or classification, but these differences must always be taken into account in developing the genetic concepts of formation of different soils discriminated on the map for a proper understanding of all the processes of formation of their profiles. Thus, in the characterized genetic understanding of soils there is a synthesis of the conceptual and substantive approaches to study of soils.

In the process of compiling the legend and map specialists define and insofar as possible solve the most debatable and unclear classification and terminological problems. In developing a list of cartographic units for a map of the Soviet Union the most important of these problems were the following: 1) discrimination of soils subjected to radical anthropogenic transformation; 2) discrimination of acidic soils with a brown undifferentiated profile; 3) discrimination of gleyey soils; 4) discrimination of soils of young alluvial plains in different zones; 5) discrimination of permafrost and some other soils. We will cite the principal solutions of these problems.

Among the anthropogenic soils the discrimination of irrigated soils has been developed best. A large group of old irrigated soils is discriminated.

Soils with a brown undifferentiated profile are represented by two groups of cartographic units: a) sub-browns -- soils with a profile A_o-B_{pf}-C, which earlier were defined as cryptopodzolic, permafrost-ferruginous, tundra illuvial-humus, etc., b) brown earths -- acidic and weakly acidic soils with fulvate humus and a profile A_o-A_I-B_t-C.

It was deemed desirable to discriminate a large group of soils combined under the common term "gleyey" which included soils with a profile A_0-G-C, earlier discriminated in the swampy, tundra, peaty-gleyey and other groups.

The soils which during the entire year remain a frozen horizon cemented by ice are discriminated as permafrost.

The described variants of solutions in the future will also prove to be useful in working on strictly classification problems.

In order to convey information on the spatial interrelationships of soils we carried out a classification of the structures of the soil cover in two coordinates:

the first takes into account the presence and nature of genetic-geochemical interrelationships between soils and the second is a genetic-geometric pattern which the soils form in the terrain.

Depending on the nature of the geochemical relationships it is possible to define three types of contrast combinations: complexes -- between the components there is a bilateral geochemical relationship; combinations -- combinations with a unilateral geochemical relationship; and mosaics -- there is no geochemical relationship among the components.

A classification of genetic-geometric forms made it possible to discriminate about 20 types of structures functionally related primarily with the peculiarities of modern or ancient relief and rock formation and in part with the influence of other factors reflecting important characteristics of the geography and the evolution of the soil cover and in many respects determining the peculiarities of the economic use of territories. Structures of one composition (for example, chestnut and saline soils), but with a different genetic-geometric pattern (for example, "annular" -- around lakes, around swamps, etc., "fanlike" -- alluvial fans and continental deltas, "treelike" -- erosional network, "rounded-spotty" -- slumping, subsidence, and similar forms of micro- and mesorelief) reflect a different structure and different processes of development of the soil cover and differ substantially with respect to the possibilities of use and the group of methods for land improvement and cultural-technical measures for homogenization of the soil cover. Each contour on the map is characterized both by the composition of the soils forming it and by the character of the combinations (complexes, combinations, mosaics) and the type of geometric pattern.

Cartographic procedures for depicting soil cover structures are differentiated for simple contours and three types of complex contours:

Simple contours: the predominant soil occupies more than 85% of the area of the contour or the soil cover is low-contrast, the spatial changes in soil-forming processes are weak, and the diversity of soils exerts no significant influence on economic use when employing the pertinent methods. The predominant soil is shown on a map by a special color and indices are employed for the primary and secondary soils.

Complex contours of the first type: the soils do not form clearly expressed combinations and their changes are not regular. The soil cover is contrasting; its diversity exerts an influence on the economic use of soils but it is possible to use the different contours differently. The predominant soil is depicted in color; indices are employed for the predominating and secondary soils; and out-of-scale symbols are used for secondary soils.

Complex contours of the second type: fine-contour, contrasting, well-expressed combinations with a clear regularity of the spatial changes in the processes of soil formation and soils; the diversity of the soil cover exerts a considerable influence on economic use and therefore they are in need (for agricultural use) of melioration for eliminating nonuniformities (homogenization) of the soil cover, in addition to other possible melioration; different use of different contours is impossible. Representation is by color typographic grids and indices. The color of the grid corresponds to the color adopted for the predominant soil and its form is a genetic-geometric type of soil cover structure. The complex index for such a contour includes symbols reflecting the composition of the soil cover and spatial regularities.

Complex contours of the third type: large-contour contrasting combinations; different use of different soil contours is possible; homogenization is not required for all practical purposes. The representation method is similar to the second type but the grids are less contrasting.

For contours whose soil cover has complexities of two or three orders (for example, a combination of complexes), by means of grids it is possible to depict the most significant type of structure and total information on the complexity (to the third order inclusive) is represented by a complex index. In addition to those enumerated, two special forms of soil cover

are discriminated: elevation-differentiated and exposure-differentiated.

The possibilities of scientific and applied use of general soils maps are increased considerably if the map carries information on the environmental conditions to one degree or another favoring or limiting the possibilities of different forms of use of land resources. Different methods are used for representing them. The peculiarities of relief are imparted by white shading and mountains, areas predominantly not in agricultural use, are shaded most expressively. In addition, undissected plains and also dissected plains and foothills where agricultural use is restricted to some degree by relief are noted. Using a system of black shading and out-of-scale symbols it is possible to impart the peculiarities of composition of rocks. Inset maps show the agroclimatic peculiarities of the area (agroclimatic regionalization).

The successive application of the expounded principles will make it possible to obtain a map with a high information capacity. Each contour on such a map conveys information on the predominant soil, secondary soils, presence and nature of the geochemical interaction among soils, geometric pattern of the soil cover, peculiarities of rocks, relief and climate and on the presence of some additional soil peculiarities (dry permafrost, soil erosion, etc.). At the same time, map design is such that the map clearly reflects the principal soils geography patterns: latitudinal and meridional zones, mountainous territories, etc.

An important requirement on a general soils map is high accuracy. A substantial increase in accuracy, especially in the representation of soil cover structures, is attained by the use of space photographs.